CLAIMS

What is claimed is:

1. An apparatus for automatically embossing carrier pockets in a continuous strip of plastic material to form a carrier tape, the apparatus comprising:

a guide structure for positioning and guiding the strip in the apparatus;

a drive assembly adapted to selectively engage and feed the strip through the guide structure in a sequence of uniform increments;

a heating assembly adapted to heat at least one region on each increment of the strip, the heating assembly including a selectively positionable portion adapted to apply heat to the strip at the at least one region, the portion being positionable in a retracted position spaced apart from the strip;

a heat shield assembly arranged to selectively interpose a heat shield between of the portion and the strip when the portion is positioned in the retracted position; and

a molding assembly for molding the heated region into a pocket, the molding assembly including a pair of mold portions selectively contactable with the at least one pocket region, the pair of mold portions including a male mold portion and a corresponding female mold portion.

2. The apparatus of claim 1, wherein said drive assembly includes a drive roller and an opposing friction roller positioned so as to frictionally engage the strip therebetween.

3. The apparatus of claim 2, wherein the friction roller is selectively positionable in at least a first position wherein the friction roller is engaged with the strip and a second position wherein the friction roller is spaced apart from the strip.

4. The apparatus of claim 2, wherein the drive roller is driven by a servo-motor.

5. The apparatus of claim 1, wherein the strip of plastic material has at least one series of uniformly spaced sprocket holes defined therethrough, and wherein the molding assembly has a plurality of pilot pins adapted to be selectively engageable with the sprocket holes to position the strip when the mold portions are contacted with the pocket region.

6. The apparatus of claim 5, wherein the drive mechanism is arranged to disengage from the strip when the pilot pins engage with the sprocket holes.

7. The apparatus of claim 1, wherein the heat shield assembly includes a body portion and a pair of spaced apart shield plate portions projecting therefrom, the shield plate portions adapted to be selectively positionable so that each shield member is disposed between the strip and a separate contact portion of the heating assembly.

8. The apparatus of claim 9, wherein said heat shield assembly includes a pair of air diffusers in the body portion, each diffuser positioned so as to direct air onto a surface of a separate one of the shield plate portions.

9. The apparatus of claim 1, wherein the heat shield is an air curtain.

10. The apparatus of claim 1, further comprising a punching assembly, the punching assembly having at least one punch pin arranged to be selectively contactable with the pocket so as to punch a hole therein.

11. The apparatus of claim 10, wherein the punch pin has a shaft with a head portion defined at a distal end thereof, the head having a first cross-sectional dimension, the shaft further having a portion with a second cross sectional dimension adjacent the head portion, the second cross-sectional dimension being less than the first cross-sectional dimension.

12. The apparatus of claim 1, further comprising an indexing assembly for accurately positioning the strip in the guide structure.

13. The apparatus of claim 12, wherein the strip of plastic material has at least one series of uniformly spaced sprocket holes formed therethrough and wherein the indexing assembly includes a ball detent mechanism having a ball portion positioned and adapted to selectively engage and register the sprocket holes.

14. The apparatus of claim 12, wherein the strip of plastic material has at least one series of uniformly spaced sprocket holes formed therethrough and wherein the indexing assembly includes a light sensor to register the sprocket holes.

15. The apparatus of claim 1, wherein the strip of plastic material is wound on a reel, and further comprising a feed control mechanism to selectively feed the strip to the drive mechanism from the reel.

16. The apparatus of claim 1, wherein the apparatus includes a control system operably connected at least with the drive assembly, the heating assembly, the heat shield assembly, and the molding assembly.

17. The apparatus of claim 15, wherein the control system defines a normal automatic 6operating mode for the apparatus, wherein the uniform increments are successively automatically fed to the heating assembly and the molding assembly through the guide structure using the drive mechanism, and a selectively actuatable pause mode, wherein the strip is held stationary in the guide structure, the portion is positioned in the retracted position, and the heat shield is positioned between the portions and the strip.

18. The apparatus of claim 17, further comprising a synchronizing assembly arranged to receive embossed carrier tape from the apparatus, the synchronizing assembly including a pair of sensors, a first sensor of said pair being arranged to generate a signal when the amount of carrier tape present in the synchronizing assembly is in excess of a first predetermined amount and a second sensor of said pair being arranged to generate a signal when the amount of carrier tape present in the synchronizing assembly is less than a second predetermined amount.

19. The apparatus of claim 18, wherein each of the pair of sensors is operably connected with the control system, and wherein the control system is adapted to automatically initiate the pause mode when the amount of carrier tape present in the synchronizing assembly is in excess of the first predetermined amount and to automatically initiate the normal automatic operating mode when the amount of carrier tape present in the synchronizing assembly is less than a second predetermined amount.

20. The apparatus of claim 1, wherein the female mold portion has an opening defined therein, the opening selectively operably connected with a supply of compressed gas, and wherein a stream of compressed gas is selectively directed from the opening against the strip to urge the strip against the male mold.

21. The apparatus of claim 1, wherein the guide structure is oriented generally vertically so that the strip passes through at least the heating assembly in along a generally vertical path.

22. A process for producing a continuous plastic carrier tape having uniformly spaced embossed pockets, and continuously supplying the tape to processing equipment wherein the carrier tape is further processed, the process including the steps of:

(a) producing the carrier tape using a carrier tape embossing apparatus adapted to perform an embossing process wherein the pockets are automatically sequentially embossed in adjacent uniform increments of the strip by sequential contact with a heating assembly and a separate molding assembly so as to produce the carrier tape at a continuous tape production rate,

the apparatus adapted so that the embossing process is selectively intermittently pausable without causing damage to the strip of plastic material;

(b) supplying the carrier tape to a piece of carrier tape processing equipment, the equipment adapted to accept the carrier tape at a tape input rate;

(c) sensing a parameter related to the tape production rate using a first sensor;

(d) sensing a parameter related to the tape input rate using a second sensor;

(e) using a processor operably connected with the first and second sensors and the carrier tape embossing apparatus to intermittently pause the embossing process so that the tape production rate substantially equals the tape input rate.

23. The process of claim 22, wherein the carrier tape processing equipment includes an automatic component loading apparatus for loading a component in each pocket of the carrier tape, and wherein the process further includes a step of loading a component into each pocket of the carrier tape.

24. The process of claim 23, wherein the carrier tape processing equipment further includes an apparatus for applying a cover tape over the pockets, and wherein the process further includes a step of applying the cover tape over the pockets.

25. The process of claim 22, wherein the heating assembly includes a pair of contact portions selectively positionable so as to contact opposite sides of the strip to heat a region of each increment, wherein the carrier tape embossing apparatus further includes a heat shield assembly adapted to selectively interpose a heat shield between each contact surface and the strip when the

process is paused, and wherein the process further includes a step of interposing the heat shields between each contact surface and the strip when the embossing process is paused.

26. The process of claim 25, wherein the heat shield assembly includes a body portion and a pair of spaced apart shield plate portions projecting therefrom, the shield plate portions adapted to be selectively positionable so that each shield member is disposed between the strip and a separate one of the contact portions, and wherein the step of interposing heat shields between each contact surface and the strip includes interposing a separate one of the shield plate portions between a separate one of the contact portions and the strip.

27. The process of claim 26, wherein said heat shield assembly includes a pair of air diffusers in the body portion, each diffuser positioned so as to direct air onto a surface of a separate one of the shield plate portions, and wherein the process further comprising a step of directing air onto the surface of each shield plate portion.

28. A process for forming a uniform series of carrier pockets in a continuous strip of plastic material to form a carrier tape by sequentially embossing at least one carrier pocket in adjacent increments of the strip, the process including the steps of:

(a) automatically positioning an increment of the strip between a pair of opposing selectively positionable heating contact surfaces;

(b) momentarily contacting the strip with the contact surfaces so as to heat a region of the increment to a forming temperature;

(c) positioning the increment so that the region is between a pair of selectively positionable mold members, the pair of mold members including a male mold member and a female mold member;

(d) engaging the region with the male and female mold members to form the pocket;

(e) selectively intermittently pausing the process by maintaining the strip in a fixed position and interposing a heat shield between each heating contact surface and the strip to inhibit heat transfer from the contact surfaces to the strip; and

(f) repeating steps (a), (b), (c),(d), and (e) for adjacent increments of the strip.

29. The process of claim 28, further comprising steps of sensing a parameter related to a tape production rate using a first sensor operably connected with a processor, using the processor to compare the parameter with a desired value for the parameter, and using the processor to initiate the step of selectively intermittently pausing the process based on a result of the comparison.

30. An apparatus for automatically embossing carrier pockets in a continuous strip of plastic material to form a carrier tape by a process including the steps of automatically positioning successive uniform increments of the strip between a pair of opposing selectively positionable heating contact surfaces, momentarily contacting the strip with the contact surfaces so as to heat a region of the increment to a forming temperature, positioning the increment so that the heated region is between a male mold member and a female mold member, and engaging the region with the male and female mold members to form the pocket, the apparatus including a heat shield assembly adapted to selectively interpose a heat shield between each contact surface and

the strip when the process is paused, thereby preventing heat damage to the strip resulting from excessive heat transfer between the contact surfaces and the strip.

31. The apparatus of claim 30, wherein the heat shield assembly includes a body portion and a pair of spaced apart shield plate portions projecting therefrom, the shield plate portions adapted to be selectively positionable so that each shield member is disposed between the strip and a separate one of the contact portions.

32. The apparatus of claim 31, wherein said heat shield assembly includes a pair of air diffusers in the body portion, each diffuser positioned so as to direct air onto a surface of a separate one of the shield plate portions.

33. The apparatus of claim 30, wherein the heat shield is an air curtain.

34. An apparatus for automatically embossing carrier pockets in a continuous strip of plastic material to form a carrier tape, the apparatus comprising:

means for positioning and guiding the strip in the apparatus;

means for selectively engaging and feeding the strip through the guide structure in a sequence of adjacent uniform increments;

means for heating at least one region on each increment of the strip,

means for selectively shielding the strip from the heating means; and

means for molding the heated region into a pocket.

35. The apparatus of claim 34, wherein said means for selectively engaging and feeding the strip through the guide structure includes a drive roller and an opposing friction roller positioned so as to frictionally engage the strip therebetween.

36. The apparatus of claim 35, wherein the friction roller is selectively positionable in at least a first position wherein the friction roller is engaged with the strip and a second position wherein the friction roller is spaced apart from the strip.

37. The apparatus of claim 35, wherein the drive roller is driven by a servo-motor.

38. The apparatus of claim 34, wherein the means for molding includes a molding assembly with a male mold and a female mold arranged to be selectively engageable with opposite sides of the strip at the heated region.

39. The apparatus of claim 38, wherein the strip of plastic material has at least one series of uniformly spaced sprocket holes defined therethrough, and wherein the molding assembly has a plurality of pilot pins adapted to be selectively engageable with the sprocket holes to position the strip when the male and female mold portions are contacted with the heated region.

40. The apparatus of claim 39, wherein the means for selectively engaging and feeding the strip is arranged to disengage from the strip when the pilot pins engage with the sprocket holes.

41. The apparatus of claim 38, wherein the female mold portion has an opening defined therein, the opening selectively operably connected with a supply of compressed gas, and wherein a stream of compressed gas is selectively directed from the opening against the strip to urge the strip against the male mold.

42. The apparatus of claim 34, wherein the means for selectively shielding the strip from the heating means includes a heat shield assembly with a body portion and a shield plate portion projecting therefrom, the shield plate portion adapted to be selectively positionable so that the shield member is disposed between the strip and the heating means.

43. The apparatus of claim 34, wherein the means for selectively shielding the strip from the heating means is an air curtain.

44. The apparatus of claim 34, further comprising punching means for punching a hole in the pocket.

45. The apparatus of claim 44, wherein the punching means includes at least one punch pin, the punch pin having a shaft with a head portion defined at a distal end thereof, the head having a first cross-sectional dimension, the shaft further having a portion with a second cross sectional dimension adjacent the head portion, the second cross-sectional dimension being less than the first cross-sectional dimension.

46. The apparatus of claim 34, further comprising indexing means for accurately positioning the strip in the guide structure.

47. The apparatus of claim 46, wherein the strip of plastic material has at least one series of uniformly spaced sprocket holes formed therethrough and wherein the indexing means includes a ball detent mechanism having a ball portion positioned and adapted to selectively engage and register the sprocket holes.

48. The apparatus of claim 43, wherein the strip of plastic material has at least one series of uniformly spaced sprocket holes formed therethrough and wherein the indexing assembly includes a light sensor to register the sprocket holes.

49. The apparatus of claim 34, wherein the strip of plastic material is wound on a reel, and further comprising feed control means for selectively feeding the strip to the means for selectively engaging and feeding the strip from the reel.

50. The apparatus of claim 34, wherein the apparatus includes control means operably connected at least with the means for selectively engaging and feeding the strip, the means for heating at least one region on each increment of the strip, the means for selectively shielding the strip from the heating means, and the means for molding the heated region into a pocket.